



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:  
Sam-Shajing SUN ] Confirmation No.: 2469  
Application No. 10/714,230 ] Art Unit: 1709  
Filed: November 14, 2003 ] Examiner: Asha J. Hall  
For: PHOTOVOLTAIC DEVICES ] Attorney Docket No: 036021.0001  
BASED ON A NOVEL  
BLOCK COPOLYMER ]

Mail Stop Petition  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

**PETITION FOR THE ACCEPTANCE OF UNINTENTIONALLY  
DELAYED CLAIM FOR PRIORITY UNDER 37 CFR § 1.78(a)**

Dear Sir/Madam:

Applicant hereby petitions for the acceptance of the unintentionally delayed claim for priority under 37 CFR 1.78(a) for the above-referenced pending application. The above referenced pending application was filed with a priority claim referencing a provisional patent application, but this reference included a typographic error in the serial number of such reference (i.e., the incorrect reference to U.S. Provisional Patent Application Ser. No. 60/428,108, wherein the underscored 8 should have been a 6). This typographic error of a single digit was identified upon examination. At no time did Applicant intentionally delay correction of such priority claim; the entire delay was unintentional. In summary, Applicant intended to claim priority to U.S. Provisional Patent Application Ser. No. 60/426,108. With the Commissioner's acceptance, the Applicant intends to amend the above referenced application with such a correction.

This petition is accompanied by a priority claim reference to the prior-filed provisional application, U.S. Provisional Patent Application Ser. No. 60/426,108, in

Attachment A. A copy of the U.S. Provisional Patent Application Ser. No. 60/426,108 is provided in Attachment B.

The Commissioner is therefore respectfully requested to accept this correction of the priority claim of the referenced pending application. A fee of \$ 1,370 is believed to be due for this petition. Please charge the required fee to Williams Mullen Deposit Account No. 50-0766.

Respectfully submitted,  
WILLIAMS MULLEN

Date: June 19, 2007

Customer Number: 45309  
(757) 499-8800

  
M. Bruce Harper (Reg. No. 43,659)

**Attachment A**

The present application claims priority from U.S. Provisional Patent Application Ser. No. 60/426,108, filed November 14, 2002, which is hereby incorporated by reference.

RECEIVED

15 JAN 2004

WIPO

PCT

PI 1113515

THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office

January 12, 2004

THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY FROM  
THE RECORDS OF THE UNITED STATES PATENT AND TRADEMARK  
OFFICE OF THOSE PAPERS OF THE BELOW IDENTIFIED PATENT  
APPLICATION THAT MET THE REQUIREMENTS TO BE GRANTED A  
FILING DATE.

APPLICATION NUMBER: 60/426,108

FILING DATE: November 14, 2002

RELATED PCT APPLICATION NUMBER: PCT/US03/36538

By Authority of the  
COMMISSIONER OF PATENTS AND TRADEMARKS

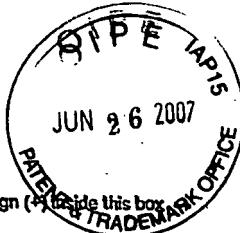


T. LAWRENCE  
Certifying Officer

PRIORITY  
DOCUMENT

SUBMITTED OR TRANSMITTED IN  
COMPLIANCE WITH RULE 17.1(a) OR (b)

11/14/02  
U.S. PTO



11-15-02

60426408 .111402A/1

Please type a plus sign (+) inside this box

+

SUBSTITUTE FOR PTO/SB/16 (2-98)

Approved for use through 01/31/2001. OMB 0651-0037

Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE  
OMB control number.

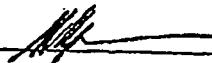
## PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53 (c).

INVENTOR(S)		
Given Name (first and middle if any)	Family Name or Surname	Residence (City and either State or Foreign Country)
Sam-Shajing	Sun	427 Willow Brook Way Chesapeake VA 23320
<input type="checkbox"/> Additional inventors are being named on the _____ separately numbered sheets attached hereto		
<b>TITLE OF THE INVENTION</b> (280 characters max) A Photovoltaic Device Based on Conjugated Block Copolymers		
<b>CORRESPONDENCE ADDRESS</b> Direct all correspondence to: <input checked="" type="checkbox"/> Customer Number 43659 → <span style="border: 1px solid black; padding: 2px;">Place Customer Number Bar Code Label here</span> OR <span style="border: 1px solid black; padding: 2px;">Type Customer Number here</span>		
<input checked="" type="checkbox"/> Firm or Individual Name M. Bruce Harper	Address Williams Mullen	Address One Columbus Center, Suite 900
City Virginia Beach	State VA	ZIP 23462
Country USA	Telephone 757-473-5357	Fax 757-473-0395
<b>ENCLOSED APPLICATION PARTS</b> (check all that apply) <input checked="" type="checkbox"/> Specification Number of Pages 3 <input type="checkbox"/> Small Entity Statement <input checked="" type="checkbox"/> Drawing(s) Number of Sheets 3 <input type="checkbox"/> Other (specify)		
<b>METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT</b> (check one) <input checked="" type="checkbox"/> A check or money order is enclosed to cover the filing fees		
<input type="checkbox"/> The Commissioner is hereby authorized to charge filing fees or credit any overpayment to Deposit Account Number: 50-0766		FILING FEE AMOUNT(\$) 75.00
The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government. <input checked="" type="checkbox"/> No. <input type="checkbox"/> Yes, the name of the U.S. Government agency and the Government contract number are: _____		

Respectfully submitted,

Date: 11/14/02

SIGNATURE 

REGISTRATION NO. 43659

TYPED or PRINTED NAME M. Bruce Harper

(if appropriate)

TELEPHONE 757-473-5357

Docket Number: 036021.0001

## USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

This collection of information is required by 37 CFR 1.51. The information is used by the public to file (and by the PTO to process) a provisional application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 8 hours to complete, including gathering, preparing, and submitting the complete provisional application to the PTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, Washington, D.C., 20231. DO NOT SEND FEES OR

11/14/02  
U.S. PTO  
JCS73 U.S. PTO  
JCS60/426108

Q P E  
JUN 26 2007  
PATENT & TRADEMARK OFFICE  
U.S. DEPARTMENT OF COMMERCE

60426108 . 111402

SUBSTITUTE FOR PTO/SB/17 (2-08)  
Approved for use through 09/30/2000. OMB 0651-0032  
Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

## FEET TRANSMITTAL

Patent fees are subject to annual revision on October 1.

These are the fees effective October 1, 1997.

Small Entity payments must be supported by a small entity statement, otherwise large entity fees must be paid. See forms PTO/SB/09-12. See 37 C.F.R. §§ 1.27 and 1.28.

**TOTAL AMOUNT OF PAYMENT** **75.00**

Complete If Known

Application Number	
Filing Date	
First Named Inventor	Sun, Sam-Shajing
Examiner Name	
Group / Art Unit	
Attorney Docket No.	036021.0001

### METHOD OF PAYMENT (check one)

1.  The Commissioner is hereby authorized to charge indicated fees and credit any over payments to:

Deposit Account Number

50-0766

Deposit Account Name

Williams Mullen

Charge Any Additional Fee Required Under 37 CFR 1.16 and 1.17

Charge the Issue Fee Set in 37 CFR 1.18 at the Mailing of the Notice of Allowance

2. Payment Enclosed:

Check  Money Order  Other

### FEE CALCULATION

#### 1. BASIC FILING FEE

Large Entity Fee Code (\$)	Small Entity Fee Code (\$)	Fee Description	Fee Paid
101	760	201	380
106	310	206	165
107	480	207	240
108	760	208	380
114	150	214	75
<b>SUBTOTAL (1)</b>			<b>(\$75.00)</b>

#### 2. EXTRA CLAIM FEES

Total Claims - **=	Extra Claims below	Fee from	Fee Paid
Independent - **=	X	=	
Claims	X	=	
Multiple Dependent		=	
**or number previously paid, if greater; For Reissues, see below			
Large Entity Fee Code (\$)	Small Entity Fee Code (\$)	Fee Description	
103	18	203	9
102	78	202	39
104	260	204	130
109	78	209	39
110	18	210	9
<b>SUBTOTAL (2) (\$)</b>			

### FEE CALCULATION (continued)

#### 3. ADDITIONAL FEES

Large Entity Fee Code (\$)	Small Entity Fee Code (\$)	Fee Description	Fee Paid
105	130	205	65
127	50	227	25
139	130	139	130
147	2,520	147	2,520
112	920*	112	920*
113	1,840*	113	1,840*
115	110	215	65
116	380	216	190
117	870	217	435
118	1,360	218	680
128	1,850	228	925
119	300	219	150
120	300	220	150
121	260	221	130
138	1,510	138	1,510
140	110	240	55
141	1,210	241	605
142	1,210	242	605
143	430	243	215
144	580	244	290
122	130	122	130
123	50	123	50
126	240	126	240
581	40	581	40
146	760	246	380
149	760	249	380
Other fee (specify)			Late filing fee/declaration surcharge
Other fee (specify)			
*Reduced by Basic Filing Fee Paid			<b>SUBTOTAL (3) (\$)</b>

### SUBMITTED BY

Typed or Printed Name

M. Bruce Harper

Complete (if applicable)

Reg. Number

43659

Signature

Date

14 NOV 02

Deposit Account User ID

50-0766

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office,



60426108.111402

**Certificate under 37 CFR 1.10 of Mailing by "Express Mail"**

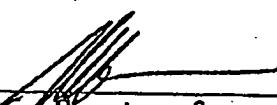
**EJ047666794US**

"Express Mail" label number

**14 Nov 02**

Date of Deposit

I hereby certify that this correspondence is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to the Box PROVISIONAL PATENT APPLICATION, Assistant Commissioner for Patents, Washington, D.C. 20231.

  
Signature of person mailing correspondence

**M. Bruce HARPER**

Typed or printed name of person mailing correspondence

Note: Each paper must have its own certificate of mailing by "Express Mail".

036021.0001

Title: A Photovoltaic Device Based on Conjugated Block Copolymers  
Inventor: Sam-Shajing Sun

## **A Photovoltaic Device Based on Conjugated Block Copolymers**

### **BACKGROUND OF THE INVENTION**

#### **Field of the Invention:**

The present invention relates to the field of photovoltaic or opto-electronic devices. More particularly, this invention relates to cost effective, lightweight, and flexible shaped "plastic" photo detectors and "plastic" solar cells (renewable and clean energy generation), etc.

#### **Background**

Photovoltaic (PV) is a process where light is absorbed by a media and is then converted into a voltage or electric current. When light strikes certain materials, the photons in the light excite electrons in the material. In some materials, there are free electrons that are released by the interaction with the photon; the movement of that electron leaves a hole. The flow of the electron, along with the resulting holes creates electric current. Most of the PV cells used today are based on inorganic semiconductor materials such as silicon, although other materials, such as Gallium Arsenide, Cadmium Telluride, Copper Indium Diselenide are also used.

The typical silicon based solar cell uses a semiconductor pn-junction. The cell comprises semiconductor layers, one of which is n-doped (doped with atoms of excess valence electrons) and the other is p-doped (doped with atoms lacking a valence electron); their interface forms a pn-junction. The n-doped layer is characterized by

036021.0001

Title: A Photovoltaic Device Based on Conjugated Block Copolymers  
Inventor: Sam-Shajing Sun

excess electrons, while the p-doped layer is characterized by holes. In other words, the n-doped layer is a donor (D) of electrons, and the p-doped layer is an acceptor (A). Initially the doped materials reach equilibrium across the pn-junction. When sunlight strikes the material, the light is absorbed in the excitation of the excess electrons, which are released and create a charge separation along the pn-junction; a transport of electrons and holes creates the electrical current that is collected by electrodes.

The high cost of manufacturing traditional inorganic photovoltaic materials and devices has led to significant research into alternative photovoltaic materials, as well as how to configure those materials within the solar cells. Additionally, improved efficiency could lower the lifetime cost and make photovoltaic devices a more commercially attractive and environmentally friendly energy alternative. One area of research is the use of organic materials to fabricate solar cells, such as using semi-conducting conjugated polymers, liquid crystalline structures, etc. Organic materials, including polymers, are relatively inexpensive, lightweight, flexible, and easily manufactured in comparison to their inorganic counterparts.

However, semi-conducting polymers work differently from inorganic semiconductors. Semi-conducting polymers are long molecules that have repeating structures and with alternating single and double carbon-carbon bonds, and are referred to as being "conjugated." The double bonds (also called  $\pi$  bonds) within conjugated polymers generate a highest occupied molecular orbital (HOMO) that is typically filled with  $\pi$  electrons, and a lowest unoccupied molecular orbital (LUMO) that is typically

036021.0001

Title: A Photovoltaic Device Based on Conjugated Block Copolymers  
Inventor: Sam-Shajing Sun

empty without light or other forms of excitation. The HOMO or LUMO of each double bond in a conjugated polymer backbone interact with each other and form HOMO and LUMO bands, the energy difference between the two bands is generally called band gap, or sometimes also called the "optical gap".

Most conjugated polymers appear to have a band gap that lies in the range of 1–3 eV, which makes them ideally suited for light harvesting or photovoltaic devices working in the visible light range. The photo-induced electron transfer and charge (electron-hole) separation observed in conjugated organic composites of the donors (electron-donating or p-type organic species) and acceptors (electron-withdrawing or n-type organic species) provide an alternative to traditional inorganic solar cells.

The mechanism for an organic approach to high efficiency light harvesting or photovoltaic conversion has been developed. Specifically, in organic photovoltaic materials, for instance, light generated excitons (e.g., electron-hole pairs) can typically diffuse 20 nm in their lifetime. The charges (electrons and holes) can be separated at the contact interface between the donors and acceptors, where for donor excitons, the electrons are transferred from donor's LUMO to the acceptor's LUMO and for acceptor excitons, the holes transferred from acceptor's HOMO to the donor's HOMO, provided that the corresponding energy level differences between the donor and acceptor are big enough to overcome the exciton binding energy (typically 0.5 eV). Next, and mainly due to the asymmetry of the photovoltaic cell, the electrons travel and are collected at the negative electrode, and holes travel and are collected at the positive electrodes. One of

036021.0001

Title: A Photovoltaic Device Based on Conjugated Block Copolymers  
Inventor: Sam-Shajing Sun

the main scientific challenges for a high efficiency organic photovoltaic device is to fabricate a nano structure where both the donor and acceptor phases have dimensions within the typical organic exciton diffusion range (about 20 nm), yet are continuous between the two electrodes.

#### DESCRIPTION OF THE INVENTION

The present invention is a potentially efficient organic photovoltaic device made of a -DBA- or an analogous block copolymer system, where D is a donor derivatized conjugated polymers, oligomers, or equivalent (also referred as "conjugated donor block"), A is an acceptor derivatized conjugated polymer, oligomer, or equivalent (also referred as "conjugated acceptor block"), B is a non-conjugated (such as aliphatic) bridge unit. The said block polymer system may also be embodied in, refer to, or be represented as -ABD-, -DBAB-, -ABDB-, -BDBA-, -BABD-, -DBABD-, -ABDBA-, etc.

The present invention comprises the structure and fabrication process of a polymer or "plastic" thin film photovoltaic device that possesses benefits of lightweight, flexible shape, cost effectiveness, and potentially very high power conversion efficiency in comparison to current commercial inorganic semi-conductor based photovoltaic devices. This "plastic" photovoltaic device has the following features:

- 1) A conjugated donor block (D) is covalently connected with a conjugated acceptor block (A) via a short non-conjugated bridge unit (B) to form a -DBA- or its analog type block copolymer chemical structure, as shown in Figure 1. Preliminary experimental

036021.0001

Title: A Photovoltaic Device Based on Conjugated Block Copolymers  
Inventor: Sam-Shajing Sun

work has shown the -DBAB- type to be a useful embodiment. Those skilled in the art will readily see that a variety of configurations could be produced for specific applications or specifications. Preferably, the donor and acceptor blocks should be chosen, configured, or built in such a way that the band gap of both donor and acceptor phases in solid states substantially match the optical radiation energy of the intended applications or devices. This -DBA- and its analog type polymer backbone structure or "Primary Structure" can be realized via common organic design and synthesis.

- 2) Additionally, both the donor and acceptor conjugated block backbones may be self-assembled in a solid thin film state to form a  $\pi$ -orbital stacked or adjacent block chain closely packed structures, as shown in Figure 2, as in many conjugated polymer systems, so that the  $\pi$ -orbitals between adjacent backbones are well coupled or overlapped to each other. This may be called a "Secondary Structure".
- 3) Additionally, the donor and acceptor block should be sufficiently different from each other, so that in solid thin film state, donor and acceptor blocks will be able to phase separate from each other as seen in many block copolymer systems. The donor and acceptor separated phases may be self-assembled to form a columnar or "Honeycomb" shaped structures, as is the general case known in many di- or tri-block copolymer systems.

036021.0001

Title: A Photovoltaic Device Based on Conjugated Block Copolymers  
Inventor: Sam-Shajing Sun

It is known that the incompatibility between the blocks leads to the formation of many unique micro- or nano-phase separated and ordered structures, including, but not limited to, lamella, columnar, cubic centered lattice, etc., and a specific phase separated structure is determined by chemical composition, size of each block, temperature, and other factors. For instance, a recent report of MEH-PPV/Polystyrene-C<sub>60</sub> donor/acceptor di-block copolymer system indeed exhibited a "honeycomb" shaped nano structure.

Each donor phase column should interface with at least one acceptor column, and vice versa. The diameter of each column should be approximately within the corresponding effective exciton diffusion length of the respective donor or acceptor blocks (typically about 20 nm).

Finally, a thin layer of donor block may be coated on one side of the columnar or "Honeycomb" structure in perpendicular to the column direction in order to form a positive side of the photovoltaic device, and a thin layer of acceptor block will likewise coated on the other side of the "Honeycomb" to form a negative side of the PV device.

Other forms of aligning or directing charge as is known in the art will serve as well. Finally, a conducting electrode with a work function close to, or substantially appropriate to the HOMO levels of the donor placed in contact to the donor (positive) layer side of the device will collect holes, and a conducting electrode with a work function close to, or substantially appropriate for the LUMO levels of the acceptor placed in contact to the acceptor layer (negative) side to collect electrons. At least one electrode should be

036021.0001

Title: A Photovoltaic Device Based on Conjugated Block Copolymers  
Inventor: Sam-Shajing Sun

transparent to the intended light radiation. This may be called "Tertiary Structure" of the said PV cell, as shown in Figure 3.

In the present invention, a -DBAB- type block copolymer system has already been synthesized and characterized recently, where D is an alkyloxy donor derivatized poly-(1,4)-phenylenevinylene (PPV), abbreviated as "RO-PPV", A is a sulfone acceptor derivatized PPV, abbreviated as "SF-PPV-I", and B is a non-conjugated aliphatic bridge unit. Preliminary electron microscopic study has revealed interesting regular nano-phase separated morphological pattern in a drop dried -DBAB- film. A donor or acceptor derivatized polythiophenes, or other similar type materials, may also be used as the conjugated blocks. A non-conjugated bridge unit provides an energy barrier between the bands of the donor and acceptor blocks in order to prevent a convenient electron-hole recombination. The bridge also makes the donor or acceptor rigid blocks less vulnerable to distortion, and more convenient to self-assemble. Conjugated  $\pi$  orbital distortion due to molecular thermal vibrations or backbone twist typically interrupts conjugation and therefore reduces charge mobility.

In summary, the backbone structure -DBA- and its analogs may be called a "Primary Structure". Since the  $\pi$  orbital overlap between rigid blocks are useful for charge mobility, this self-assembly morphology between blocks could be called a "Secondary Structure". Finally, the block copolymer "honeycomb" morphology provides

036021.0001

Title: A Photovoltaic Device Based on Conjugated Block Copolymers  
Inventor: Sam-Shajing Sun

smooth "tunnels" for charge transportation to the respective electrodes. The "honeycomb" structure may be sandwiched between a thin layer of donor film (in contact with a positive electrode), and a thin layer of acceptor film (in contact with a negative electrode) so that an efficient asymmetric polymeric photovoltaic device is thus formed. The sandwiched "honeycomb" structure can be called a "Tertiary Structure". Another advantage of this system is that the interfacial area and the phase size can be tuned via block copolymer segment size, therefore, the opto-electronic conversion efficiency can be easily optimized via materials design and synthesis.

## CLAIMS

What is claimed is:

1. A photovoltaic primary structure comprising:
  - a conjugated donor block,
  - a conjugated acceptor block, and
  - a non-conjugated bridge covalently coupling said donor block and said acceptor block.
2. The photovoltaic primary structure as described in claim 1, wherein a second non-conjugated bridge is covalently coupled to one of either said acceptor block or said donor block, and said second non-conjugated bridge is capable of coupling to other such photovoltaic primary structures to form a repeating chain.

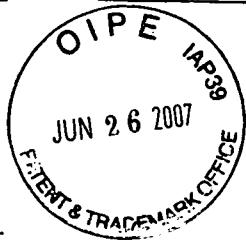
036021.0001

Title: A Photovoltaic Device Based on Conjugated Block Copolymers

Inventor: Sam-Shajing Sun

3. A photovoltaic secondary structure comprising a plurality of primary structures in a  $\pi$  orbital stack and closely packed morphology.
4. A photovoltaic tertiary structure comprising a plurality of secondary structures in a phase separated columnar nano-structure.
5. A photovoltaic tertiary structure as described in claim 4, further comprising a donor thin layer at a first end of such columnar nano-structure and an acceptor thin layer at an opposing second end of such columnar nano-structure, wherein said donor thin layer and said acceptor thin layer are oriented to such columnar nano-structure so as to form an asymmetric geometry.
6. A process for producing a photovoltaic primary structure comprising the steps of
  - producing a conjugated donor block,
  - producing a conjugated acceptor block, and
  - covalently coupling said donor block to said acceptor block with a non-conjugated bridge.

#371307 v2



60426108 .111402

Please type a plus sign (+) inside this box →

SUBSTITUTE FOR PTO/SB/01 (12-97)

Approved for use through 9/30/00. OMB 0651-0032

Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

**DECLARATION FOR UTILITY OR  
DESIGN  
PATENT APPLICATION  
(37 CFR 1.63)**

Declaration Submitted With Initial Filing      OR       Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)

Attorney Docket Number      036021.0001

First Named Inventor      Sun, Sam-Shajing

**COMPLETE IF KNOWN**

Application Number

Filing Date

Group Art Unit

Examiner Name

As a below named Inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole Inventor (if only one name is listed below) or an original, first and joint Inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

**A Photovoltaic Device Based on Conjugated Block Copolymers**

the specification of which

(Title of the Invention)

is attached hereto

OR

was filed on (MM/DD/YYYY)

as United States Application Number or PCT International

Application Number

and was amended on (MM/DD/YYYY)

(if applicable)

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT International application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT International application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? YES	Certified Copy Attached? NO
			<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)	<input type="checkbox"/> Additional provisional application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

[Page 1 of 2]

Burden Hour Statement: This form is estimated to take 0.4 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.



60426108 .111402

Please type or sign (+) inside this box → +

SUBSTITUTE FOR PTO/SB/01 (12-97)

Approved for use through 9/30/00. OMB 0651-0032

Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

## DECLARATION - Utility or Design Patent Application

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below, and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT international application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (if applicable)

Additional U.S. or PCT international application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.  
As a named Inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:  Customer Number \_\_\_\_\_ →  Place Customer Number Bar Code Label here

Registered practitioner(s) name/registration number listed below

Name	Registration Number	Name	Registration Number
M. Bruce Harper	43659		

Additional registered practitioner(s) named on supplemental Registered Practitioner Information sheet PTO/SB/02C attached hereto.

Direct all correspondence to:  Customer Number \_\_\_\_\_ OR  Correspondence address below

Name	M. Bruce Harper		
Address	Williams Mullen		
Address	One Columbus Center, Suite 900		
City	Virginia	State	VA
Country	U.S.A.	Telephone	757-473-5357
		Fax	757-473-0395

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Sole or First Inventor  A petition has been filed for this unsigned inventor

Given Name (first and middle if any)		Family Name or Surname					
Sum-Shajing		Sun					
Inventor's Signature					Date	11/14/2002	
Residence: City	Chesapeake	State	VA	Country	23320	Citizenship	USA
Post Office Address	427 Willow Brook Way						
Post Office Address							
City		State		ZIP		Country	
<input type="checkbox"/> Additional inventors are being named on the _____ supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto							

60426108 .111402

036021.0001

Title: A Photovoltaic Device Based on Conjugated Block Copolymers

Inventor: Sam-Shajing Sun

i) "Primary Structure"

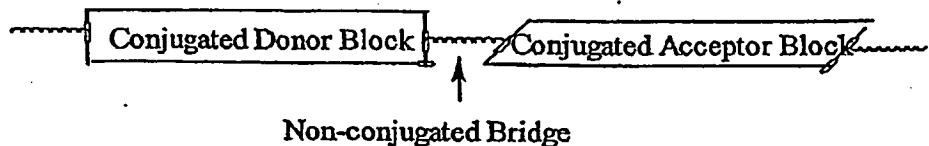


FIGURE 1

60426103 .111402

036021.0001

Title: A Photovoltaic Device Based on Conjugated Block Copolymers  
Inventor: Sam-Shajing Sun

ii) "Secondary Structure"



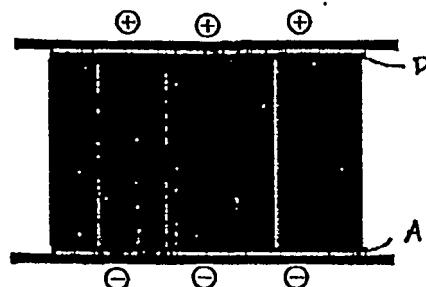
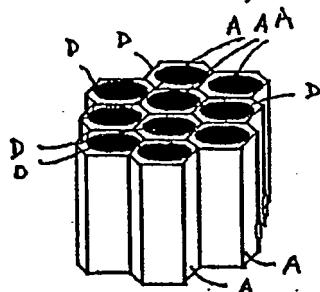
FIGURE 2

036021.0001

Title: A Photovoltaic Device Based on Conjugated Block Copolymers

Inventor: Sam-Shajing Sun

## iii) "Tertiary Structure"



iii-a) "Honeycomb" Morphology

iii-b) PV Device Architecture

FIGURE 3

#371314 v2

Appl. No. 10/714,230  
Amdt. Dated June 26, 2007  
Reply to Office action of March 26, 2007

**Attachment B**



**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

DECLARATION OF SAM-SHAJING SUN UNDER 37 C.F.R. 1.131

**CITY OF CHESAPEAKE  
COMMONWEALTH OF VIRGINIA, USA, to wit:**

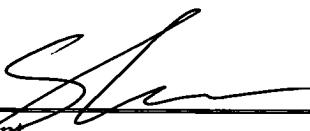
I, Sam-Shajing Sun do hereby declare:

1. I am the sole inventor of the patent application identified above and inventor of the subject matter described and claimed therein.
2. I am one of the co-authors of the cited publication, Fan, et al., ("Synthesis and Characterization of a Novel block Copolymer," Proceedings of Polymeric Materials: Science Engineering, v.86, 47, 2002). This document was cited against claims 9-17 of the above referenced application. The other co-authors of this cited publication were merely working under my direction within the Center for Materials Research at Norfolk State University.
3. In the same year as publication of this citation, I did cause to be prepared under my supervision the provisional patent application, U.S. App. Ser. No. 60/426,108, filed November 14, 2002. I am also the sole inventor of that provisional patent application. A utility patent application was then diligently prepared and filed, U.S. App. Ser. No. 10/714,230, which is the patent application identified above. This present application, in conjunction with a Petition for the Acceptance of Unintentionally Delayed Claim for Priority Under 37 CFR § 1.78(a) filed June 19, 2007, claims priority to that provisional patent application.

4. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application of any patent issued thereon.

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct. Executed on **June 26, 2007**.

5. Further declarant sayeth not.



\_\_\_\_\_  
Declarant

1198986v1

Appl. No. 10/714,230  
Amdt. Dated June 26, 2007  
Reply to Office action of March 26, 2007

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No. : 10/714,230  
Applicant : Sam-Shajing SUN  
Filed : 11/14/2003  
TC/A.U. : 1709  
Confirmation No. : 2469  
Examiner : Hall, Asha J.  
Docket No. : 036021.0001  
For: : A Photovoltaic Device Based on Conjugated Block Copolymers

**Certificate under 37 CFR 1.10 of Mailing by “Express Mail”**

EV615179103US

“Express Mail” label number

06/26/07

Date of Deposit

I hereby certify that this correspondence is being deposited with the United States Postal Service “Express Mail Post Office to Addressee” service under 37 CFR 1.10 on the date indicated above and is addressed to the Mail Stop Patents, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Sharon L. Hardee

Signature of person mailing correspondence

Sharon L. Hardee

Typed or printed name of person mailing correspondence

Note: Each paper must have its own certificate of mailing by “Express Mail”.



# UNITED STATES PATENT AND TRADEMARK OFFICE



UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
[www.uspto.gov](http://www.uspto.gov)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/714,230	11/14/2003	Sam-Shajing Sun	036021.0001	2469
22467	7590	03/26/2007	EXAMINER	
WILLIAMS MULLEN FOUNTAIN PLAZA THREE, SUITE 200 721 LAKEFRONT COMMONS NEWPORT NEWS, VA 23606			HALL, ASHA J	
ART UNIT		PAPER NUMBER		1709
SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE		
3 MONTHS	03/26/2007	PAPER		

**Please find below and/or attached an Office communication concerning this application or proceeding.**

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.



Application No.	Applicant(s)	
10/714,230	SUN, SAM-SHAJING	
Examiner	Art Unit	
Asha Hall	1709	

– The MAILING DATE of this communication appears on the cover sheet with the correspondence address –  
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

1) Responsive to communication(s) filed on 14 November 2003.  
 2a) This action is FINAL.                            2b) This action is non-final.  
 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

4) Claim(s) 1-21 is/are pending in the application.  
 4a) Of the above claim(s) 1-8 is/are withdrawn from consideration.  
 5) Claim(s) \_\_\_\_\_ is/are allowed.  
 6) Claim(s) 9-21 is/are rejected.  
 7) Claim(s) \_\_\_\_\_ is/are objected to.  
 8) Claim(s) 1-21 are subject to restriction and/or election requirement.

#### Application Papers

9) The specification is objected to by the Examiner.  
 10) The drawing(s) filed on \_\_\_\_\_ is/are: a) accepted or b) objected to by the Examiner.  
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).  
 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. § 119

12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
 a) All    b) Some \* c) None of:  
 1. Certified copies of the priority documents have been received.  
 2. Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

#### Attachment(s)

1) Notice of References Cited (PTO-892)  
 2) Notice of Draftsperson's Patent Drawing Review (PTO-948)  
 3) Information Disclosure Statement(s) (PTO/SB/08)  
 Paper No(s)/Mail Date 11/14/2003 and 12/15/2003.

4) Interview Summary (PTO-413)  
 Paper No(s)/Mail Date. \_\_\_\_\_.  
 5) Notice of Informal Patent Application  
 6) Other: \_\_\_\_\_.

Art Unit: 1709

**DETAILED ACTION*****Election/Restrictions***

1. Restriction to one of the following inventions is required under 35 U.S.C. 121:

Group I, Claim 1-8, drawn to a photovoltaic device based on block copolymer, classified in class 136, subclass 263.

Group II, Claim 9-21, drawn to a method of forming a photovoltaic block copolymer, classified in class 257, subclass 258.

2. The inventions are distinct, each from the other because of the following reasons:

Inventions II and I are related as process of making and product made. The inventions are distinct if either or both of the following can be shown: (1) that the process as claimed can be used to make another and materially different product or (2) that the product as claimed can be made by another and materially different process (MPEP § 806.05(f)). In the instant case the process as claimed can be used to make a materially different product. For example, the process claimed can be employed with other polymer materials (i.e. PMMA or poly(3-hexylthiophene)).

3. Because these inventions are independent or distinct for the reasons given above and there would be a serious burden on the examiner if restriction is not required because the inventions have acquired a separate status in the art in view of their different classification, restriction for examination purposes as indicated is proper. Because these inventions are independent or distinct for the reasons given above and there would be a serious burden on the examiner if restriction is not required because

the inventions require a different field of search (see MPEP § 808.02), restriction for examination purposes as indicated is proper.

4. Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

***Priority***

5. Applicant's claim for the benefit of a prior-filed application under 35 U.S.C. 119(e) or under 35 U.S.C. 120, 121, or 365(c) is acknowledged. Applicant has not complied with one or more conditions for receiving the benefit of an earlier filing date under 35 U.S.C. 119 (e) as follows: The applicant claims benefit to 60/428,108 on the bibliographic data sheet. The data provided by the applicant is not consistent with the Patent and Trademark Office records.

***Claim Rejections - 35 USC § 112***

6. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter, which the applicant regards as his invention.

Art Unit: 1709

7. Claims 12 and 19 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The term "easily" in claim 12 is a relative term, which renders the claim indefinite. The term "easily" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention.

The term "enhancing" in claim 19 is a relative term, which renders the claim indefinite. The term "enhancing" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention.

In claim 19, the phrase "photovoltaic block copolymer film" renders the claim unclear according to the context of the claim. As stated in the application, the photovoltaic block copolymer film contains donor and acceptor carrier materials, which are portrayed as being apart of the photovoltaic block copolymer film (paragraph 3 & Figure 12). The term of the photovoltaic block copolymer film has been interpreted as the device.

***Claim Rejections - 35 USC § 102***

8. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

Art Unit: 1709

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

9. Claims 9-16 are rejected under 35 U.S.C. 102(a) as being anticipated by Fan et al., ("Synthesis and Characterization of a Novel Block Copolymer," Proceedings of Polymeric Materials: Science & Engineering, v.86, 47, 2002).

With regard to claim 9, Fan et al. discloses the method for forming an organic photovoltaic device, comprising of synthesizing photovoltaic block copolymer samples:

- (a) dissolving the photovoltaic block copolymer samples in a solvent (paragraph 2);
- (b) filtering the copolymer-solvent mixture (paragraph 2);
- (c) forming a film of the copolymer-solvent mixture on a pretreated glass slide/prepared surface (paragraph 2);
- (d) removing the solvent/dried overnight (paragraph 2).

With respect to claim 10, Fan et al. further shows:

- (a) individually synthesizing conjugated donor chains (Figure 1), conjugated acceptor chains (Figure 1),
- (b) non-conjugated bridge chains (Figure 1);
- (c) combining the non-conjugated bridge chains with the conjugated donor chains to form a plurality of bridge-donor-bridge units; and
- (d) combining the bridge-donor-bridge units with the conjugated acceptor chains (paragraph 5).

In regard to claim 11, Fan et al. further discloses the photovoltaic block copolymer samples synthesized by:

- (a) individually synthesizing conjugated donor chains (Figure 1),
- (b) conjugated acceptor chains and non-conjugated bridge chains (Figure 1); combining the non-conjugated bridge chains with the conjugated acceptor chains to form a plurality of bridge-acceptor-bridge units (paragraph 5);
- (c) combining the bridge-acceptor-bridge units with the conjugated donor chains (Figure 1).

With respect to claim 12, Fan et al. further discloses the solvent dried overnight in the heated vacuum oven (paragraph 2).

In regard to claim 13, Fan et al. further discloses that the copolymer-solvent solution is filtered using a filter having a pore size of about 0.2 microns (paragraph 2).

With respect to claim 14, Fan et al. further discloses that the film is formed by a method selected from the group consisting of spin coating and drop drying (paragraph 2).

In regard to claim 15, Fan et al. further discloses that the prepared surface is pre-cleaned, conducting glass/pretreated glass slides (paragraph 2).

With respect to claim 16, Fan et al. further discloses that the solvent is removed by a method selected from the group consisting of heating, vacuum exposure and a combination of heating and vacuum exposure (paragraph 2).

***Claim Rejections - 35 USC § 103***

10. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

11. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over Fan et al. ("Synthesis and Characterization of a Novel Block Copolymer," Proceedings of Polymeric Materials: Science & Engineering, v.86, 47, 2002) as applied to claim 9 above, in view of Allen et al. (5,041,510) and Visscher et al., ("Construction of Multiple-Beam Optical Traps with Nanometer-Resolution Position Sensing", IEEE Journal of Selected Topics in Quantum Electronics, vol. 2, Issue 4, pages 1066-1076 (Dec. 1996)).

With respect to claim 17, Fan et al. discloses the methods with respect to claim 9 above, but fails to disclose applying to the device a force selected from the group consisting of magnetic, electrical, and optical forces. Allen et al. discloses the processing of copolymer block film (col.6; lines15-24); and discloses applying a force to polymer selected from the group consisting of magnetic and electrical (col.3; lines 66-68 & col.4; lines 1-2) forces to induce alignment of mobile dipolar copolymers (col. 3; lines 66-68). Thus, it would have been obvious to one skilled in the art at the time of the invention to apply magnetic and electrical forces as taught by Allen to modify Fan et al. in order to mobilize the dipolar (charge carriers within) copolymers.

Fan et al. in view of Allen et al. fails to disclose applying an optical force to the block copolymer. However, Visscher et al. discloses the ability to manipulate molecules with forces on a molecular scale (p. 1075) and applying the use of an optical force, (also known as "optical tweezers") to generate charge carrier displacement (to move positive and negative charges) along the polymeric tracks (p. 1066). Thus, it would have been further obvious to one skilled in the art at the time of the invention to apply an optical force as taught by Visscher et al. in modified Fan et al. in order to move the charges more effectively along the conjugated chains and towards the electric field directions.

12. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Brabec et al., ("Origin of the Open Circuit Voltage of Plastic Solar Cells", Advanced Functional Materials, vol. 11, Issue 5, pages 374-380 (2001)) in view of Sethuraman et al. (5,972,124).

In regard to claim 18, Brabec et al. discloses:

- (a) the cleaning of entire piece of conducting glass (experimental paragraph 1; p. 379);
- (b) synthesizing a photovoltaic block copolymer from conjugated donor chains, conjugated acceptor chains and non-conjugated bridge chains (experimental paragraph 1; p. 379);
- (c) spin coating the piece of conducting glass (experimental paragraph 1; p. 379) with the photovoltaic block copolymer to form a film having a thickness of about 100nm (paragraph 2.3.1; p. 376);

(d) vacuum depositing an electrode material on top of the film wherein the electrode material has a thickness of about 100nm (paragraph 2.3.2; p. 377), such that a positive electrode and a negative electrode are formed (paragraph 2.3.2; p. 377).

Brabec et al. fails to disclose a method of immersing a portion of conducting glass specifically in sulfuric acid. Whereas, Sethuraman et al. teaches a method of cleaning conducting glass (col. 4; lines: 25) and immersing a portion of a piece of conducting glass in a concentrated sulfuric acid cleaning solution (col.4; lines; 11-12 and lines: 25-29) to successfully clean the conducting glass without removing metals (col.4; lines: 34-35). Thus, it would have been obvious to one skilled in the art at the time of the invention to apply the cleaning steps as taught by Sethuraman et al. to the method of Brabec et al. in order to successfully clean the conducting glass without removing metals.

13. Claims 19 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Brabec et al., ("Origin of the Open Circuit Voltage of Plastic Solar Cells", Advanced Functional Materials, vol. 11, Issue 5, pages 374-380 (2001)) in view of Sethuraman et al. (5,972,124) as in claim 18 above, and in further view of Nava et al., ("Fullerene-functionalized polyesters: synthesis, characterization and incorporation in photovoltaic cells", New Journal of Chemistry, vol. 26, pages 1584-1589 (2002)).

With respect to claims 19 and 20, modified process of Brabec et al. discloses the elements of claim 18 as discussed above, but fails to disclose forming one or more films of carrier materials. Nava et al. discloses processing of copolymer films (paragraph 2; p. 1587) and discloses forming one or more carrier films of lithium fluoride (paragraph 2; p. 1587) and poly(ethylene dioxythiophene)/polystyrene sulfuric acid (PEDOT:PSS) (paragraph 1; p. 1587) that shows clear photovoltaic behavior(paragraph 2; p. 1587). Thus, it would have been obvious to one skilled in the art at the time of the invention to include the carrier films of lithium fluoride and poly(ethylene dioxythiophene)/polystyrene sulfuric acid (PEDOT:PSS) as taught by Nava et al. to the method of Brabec et al. in order to form one or more films that shows clear photovoltaic behavior.

14. Claim 21 is rejected under 35 U.S.C. 103(a) as being unpatentable over Brabec et al., ("Origin of the Open Circuit Voltage of Plastic Solar Cells", Advanced Functional Materials, vol. 11, Issue 5, pages 374-380 (2001)) in view of Sethuraman et al. (5,972,124) as in claim 18 above, and in further view of Hummelen et al. ("Stability issues of conjugated polymer/ fullerene solar cells from a chemical viewpoint", Proceedings of SPIE vol. 4108, (2001),p76-83).

With respect to claim 21, modified steps of Brabec et al. discloses:

- (a) the forming of a film synthesized from donor chains (holes) between the positive electrode and the photovoltaic block copolymer film (paragraph 2.3.2; p.377);

(b) and forming a film synthesized from acceptor chains (electrons) between the negative electrode the photovoltaic block copolymer film (paragraph 2.3.2; p.377).

However, modified Brabec et al. fails to disclose a photovoltaic block film with donor and acceptor chains between the positive and negative electrodes. Hummelen et al. discloses a photovoltaic block film (p.77,Figure 1b.) with synthesized donor and acceptor chains in Figure 1.b (p.77) to have the holes flow towards the positive electrode and electrons flow towards the negative electrode. Thus, it would have been obvious to one skilled in the art at the time of the invention to apply the modified steps of Brabec et al. to synthesize a photovoltaic block copolymer with donor and acceptor chains to supply a charge transfer in the photovoltaic block copolymer.

### ***Conclusion***

15. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Asha Hall whose telephone number is 571-272-9812. The examiner can normally be reached on Monday-Friday 7:30-5:00PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Alexa Neckel can be reached on 571-272-1446. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

AJH  
lph

  
ALEXA D. NECKEL  
SUPERVISORY PATENT EXAMINER